State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION
1151 Punchbowl Street, Room 221
Honolulu, Hawaii 96813

ADDENDUM NO. 1

TO

JOB NO. H53C664B
HAENA STATE PARK IWS IMPROVEMENTS
(CONSTRUCTED WETLANDS)
HAENA, KAUAI, HAWAII

MAY 25 2010

This addendum as issued shall become part of the Contract Documents for the subject project. The plans and specifications shall be amended as follows:

GENERAL INFORMATION

1. A pre-bid meeting was held on May 18, 2010. The pre-bid meeting minutes and sign-in sheet are attached for information only.

2. The archeological monitoring outline is attached. See Attachment 1.

3. The operation and maintenance manual for the constructed wetland system is attached. See Attachment 2.

Engineering Division

Carty S. Chang
Acting Chief Engineer

Ha'ena State Park Constructed Wetland:
Special Contract Provision Regarding Archaeological Monitoring and its Relationship to Construction

The constructed wetland is in the vicinity of known subsurface archaeological deposits, including a previously discovered burial adjacent to the existing septic tank. Previous work in the area suggests that there is not a concentration of burials, but the possibility of additional finds and other types of archaeological remains exists.

Archaeological monitoring will be required for all excavation associated with this project. The community has also requested that cultural descendants be allowed to observe the construction activities.

In addition to having archaeological staff present, in order to protect and gather information regarding any exposed cultural deposits during the construction, the following methodology, which was utilized during the existing leachfield construction, will be proposed in the monitoring plan:

-Trees will have to be removed carefully, by cutting rather than grubbing whenever possible-.

-In areas which will be excavated below the current surface (most notably in the septic tank and leach field areas), the contractor, working with the archaeologists, must utilize a smooth-bladed backhoe to remove overlying disturbed deposits to clearly expose any potential intact cultural layers below. Any exposed features can then be carefully evaluated, recorded and sampled by the archaeologists. If significant deposits are uncovered, ample time will need to be taken in order to complete the archaeological analyses. Other project components can be worked while the analyses are completed.

-Should burials or human remains be uncovered by the work, the State Historic Preservation Division shall be consulted as the agency with the authority to determine proper treatment. This has the potential to cause delays and to shift the design of project components.

This methodology will be specified in the archaeological monitoring plan to be prepared for the project.

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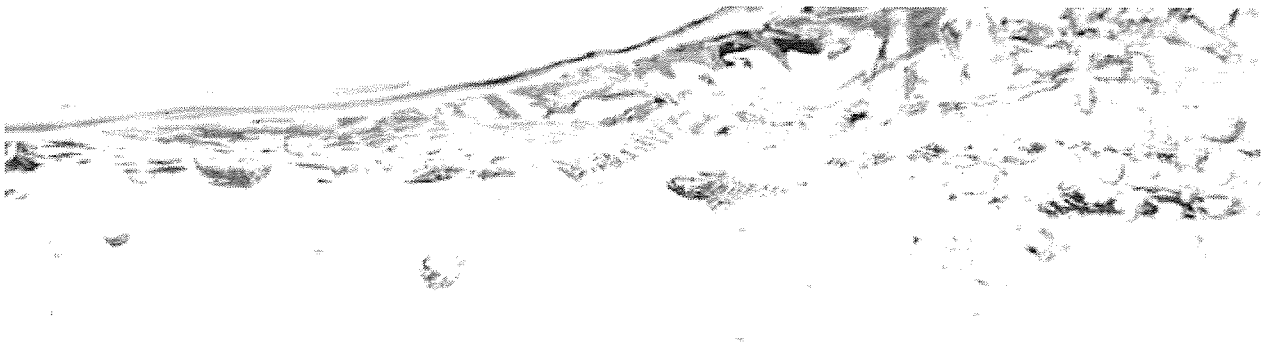
OPERATIONS AND MAINTENANCE MANUAL
DRAFT

HA'ENA STATE PARK WASTEWATER TREATMENT SYSTEM

KAUAI, HAWAII
DLNR Job No: H53C664B
Owner: State of Hawaii Department of Land & Natural Resources



IMPORTANT! FAILURE TO FOLLOW THE OPERATING INSTRUCTIONS IN THIS MANUAL MAY RESULT IN THE FAILURE OF THE WASTEWATER TREATMENT SYSTEM. THIS MAY RESULT IN SEVERE FINANCIAL PENALTIES BEING LEVIED BY THE ENVIRONMENTAL PROTECTION AGENCY.

This Operation and Maintenance manual is a supplement to the manual provided by the Contractor. That original manual consisted of specific instructions, in the form of catalog cuts for the ongoing (periodic) maintenance of the mechanical components of the system.

It should be emphasized that the Operation and Maintenance Manual presented here is only a preliminary conceptual guide and is intended to provide general technical assistance to trained operating personnel. It is not a comprehensive listing of causes and solutions, nor is it a substitute for knowledge gained by "hands on" experience.

May 2010

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1.0 INTRODUCTION

Wastewater management at the Ha'ena State Park Comfort Station is provided by an onsite Wastewater Treatment System consisting of primary treatment tanks, subsurface flow constructed wetlands and subsurface infiltration. The system is entirely passive (no pumps), but does require periodic, preventative maintenance to ensure that operations are effective and safe, and for the long-term viability of the system.

The Wastewater Treatment System has three components. Effluent from the Comfort Station fixtures is first collected through the existing 4" plumbing and conveyed to the new primary treatment tanks. Subsurface constructed wetlands provide secondary treatment and an infiltration field provides disposal. The existing primary treatment tank and leach field have been left in-place and operational, and can be utilized in emergency or back-up situations by operating the diversion valves located just outside of the Comfort Station. The existing system should not be utilized during normal operations.

This Manual covers the operation and maintenance of the Wastewater Treatment System. Plans and specifications should be referenced when reviewing this Manual. This system was designed with the following influent wastewater quality limitations:

Nutrient Mass Loading Rates:	2.66 lb BOD /day
	1.51 lb TSS /day
	1.33 lb TN /day
Flow Rate:	2,100 gallons per day (gpd)

To calculate loading rates: Flow (GPD) x BOD5 or TN or TSS (mg/L) x 0.00000834 = lb BOD5/day

SYSTEM OVERVIEW

The Ha'ena State Park Wastewater Treatment System consists of three separate elements of collection, treatment and infiltration. Together, these separate elements contribute to the treatment of 2,100 gallons of wastewater per day. The individual treatment, control, and delivery units of the treatment system are:

ELEMENT	FUNCTION
1. Water Diversion Valves (control)	The first element of the treatment system is a set of diversion valves that enable the operator to isolate the existing treatment system so all wastewater flow goes to the new constructed wetland treatment system.
2. Fiberglass Pretreatment Tank (Treatment)	Conventional single compartment 1500 gallon septic tank. BOD reduction and TSS reduction occurs in this phase.
3. Fiberglass Pretreatment Tank (Treatment)	Conventional single compartment 1500 gallon septic tank with effluent filter and high level alarm. Flows to constructed wetlands. BOD reduction and TSS reduction.
3. Constructed Wetlands (Treatment)	BOD reduction, Nitrogen and Phosphorus reduction, in addition to partial pathogen reduction.
4. Level Adjust Sump (Control)	Maintains constant water level in the constructed wetland cell.
8. Subsurface Disposal Field (Treatment)	Disposal Field infiltrates final effluent into the soil.

2.0 INDIVIDUAL COMPONENT OVERVIEW AND MAINTENANCE

Each component of the wastewater system requires specific maintenance. Periodic checking is important to ensure that each component is working properly. These checks are described under each section below.

I. DIVERSION VALVES

A. OVERVIEW

The Diversion valves control flow between the existing primary treatment (septic) tank and the new primary treatment tanks. These valves and the associated cleanouts allow the operator to toggle between the two systems. The existing system shall *only* be used in the event of maintenance (liner or plumbing repair, etc), or system malfunction (surfacing at the infiltration field).

B. CONTROLS

During normal operation the valve to existing treatment system will be closed and the valve to the new treatment system will be open.

C. MAINTENANCE

The valves should be opened and closed semi-annually to ensure they function properly. The associated cleanouts can be used to clean lines if needed.

D. TROUBLESHOOTING

If it is difficult or impossible to move the slide valve up or down, the valve will need to be removed from the pipe and cleaned.

E. COMPONENT GRAPHIC

The component images follow on the next page.

COMPONENT IMAGES

[Insert photograph of installed diversion valves after construction]

II. FIBERGLASS PRETREATMENT TANKS

A. OVERVIEW

The treatment system for Ha'ena State Park has two 1500 gallon pretreatment tanks plumbed in series. The first tank is as single compartment tank with no effluent filter. The second tank has an effluent filter and high level alarm float to indicate when the filter has clogged. The effluent filter is essential to protecting the downstream components from excessive solids carry-over and must be maintained. At no time should the system be operated without the effluent filter in place. Note: all access lids must be kept securely bolted with tamper-resistant bolts before and after maintenance activities.

B. CONTROLS AND ALARMS

The high level alarm will activate if the liquid level in the second tank reaches a pre-determined point. Activation of the alarm is an indication that the effluent filter is clogged and requires cleaning. This alarm float should be set to activate if the liquid level reaches half way up the discharge outlet pipe. Follow instructions for cleaning in the maintenance section. If alarm conditions are happening frequently, check to make sure the float is properly located. Note: the alarm will not activated due to clogging or backups further downstream.

C. MAINTENANCE

The operator shall inspect the effluent filter **monthly** during the first year. Depending on sludge accumulation during that period, a new maintenance schedule can be created to ensure the filter stays clean with least number of cleaning operations.

1. CLEANING

The effluent filter must be checked on a monthly basis by the operator. The effluent filter cartridge should be pulled up and washed off over the *first* access port to the tank. Failure to maintain the effluent filter will lead to clogging and possible flooding of the tanks.

2. TANK PUMPING

When it is time for the primary treatment tanks to be pumped, the pumper should be given the following instructions:

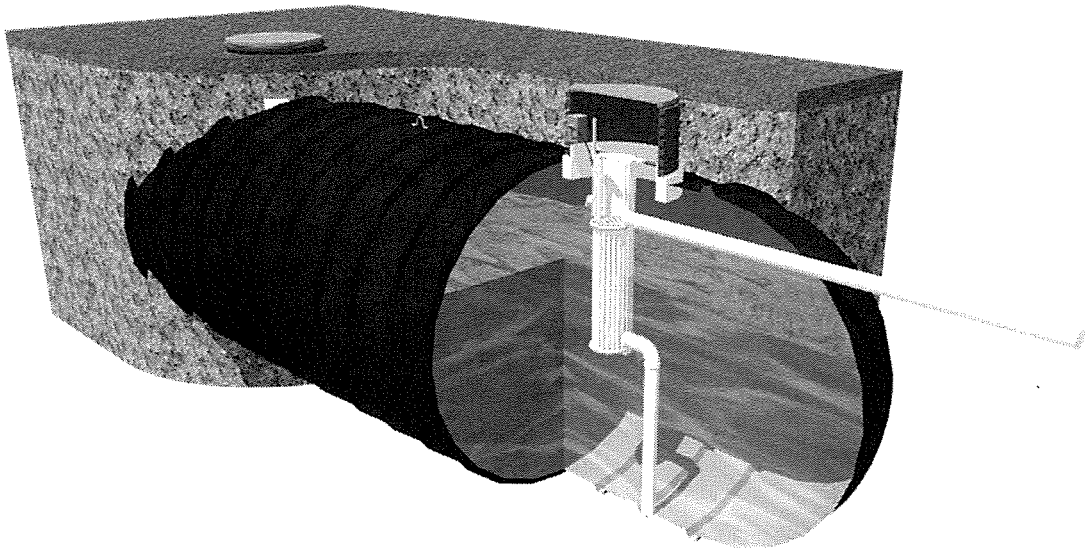
The pump vault or effluent filter must be removed before pumping (second tank only). Otherwise the scum mat on top is drawn past the inlet ports and can cause future clogging problems. Also, to avoid tank floatation, the pump tank must be refilled with water to a level above the inlet ports after pumping and before introducing new sewage into the tank.

NOTE: The pretreatment tanks are considered a confined space and all OSHA guidelines for entering a confined space must be followed.

D. TROUBLESHOOTING

If the high level alarm activates check the effluent filter for clogging. Note: the alarm will not activated due to clogging or backups further downstream.

E. COMPONENT GRAPHIC

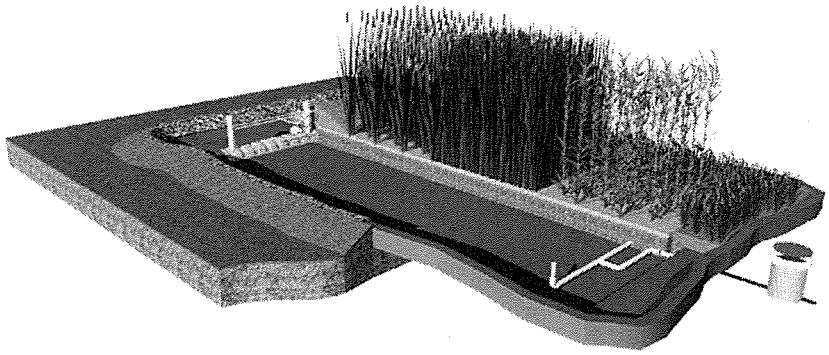


Typical Primary Treatment Tank with Effluent Filter (Gravity)

III. CONSTRUCTED WETLAND

A. OVERVIEW

The Constructed Wetland is a biological filter that removes organic and inorganic contaminates. Constructed wetlands perform limited nitrification, denitrification, BOD reduction, TSS Reduction and pathogen removal. Wastewater treatment in the wetlands is the result of bacterial digestion of organic and inorganic compounds. Bacteria account for approximately 90% of the treatment process. Any disruption of the bacterial population will have an immediate and significant impact on the level of treatment. Disruption may be chemical or thermal. Bacterial activity is temperature dependent and reaction rates generally halve with a 10° C drop in temperature.



Typical Subsurface Flow Constructed Wetlands – Cutaway View

B. CONTROLS

1. LEVEL ADJUST BASIN

The water level in the Constructed Wetland cell is controlled by a level adjust basin. The principle of operation is that water is displaced through a standpipe/arm connected to the outflow from the basin.

Raise the standpipe, wetland water level raises. Lower the standpipe, wetland water level lowers. Raising and lowering is achieved by physically pushing the standpipe arm to the desired location. A line of poly rope can be used to hang the standpipe in place if it does not stay on its own. The elevation of the standpipe should be initially set so that the water level in the Constructed Wetland is two (2) inches below the gravel surface. After the plants become established, the standpipe should be adjusted so that the water level is maintained at four (4) inches below the gravel surface.

At no time during normal operations should there be water surfacing in the constructed wetland cell. The excess effluent should always flow freely out of the level adjust sump. If it does not, check for blockages in the collection piping. During

and after large rain events, some temporary surfacing may occur, which is normal and expected in an area with high rainfall.

As the plants mature, the level of the water in the wetlands should be lowered if there is standing water in the front of the wetlands. Periodic adjustment may be required every spring. Do not lower over 4 inches below the gravel surface without consulting with Engineer first.

The sump should be opened on a monthly basis to inspect for flow. When this sump is opened, water should be flowing into the vertical standpipe. If no water is moving, the system should be checked upstream for possible leaks or blockages. Operators should be careful to avoid getting debris such as leaves, grass or sticks into the sump.

COMPONENT GRAPHIC

[insert photographs of level adjust sump]

C. MAINTENANCE

Constructed wetlands in many regards are self-maintaining and self-regulating and require limited maintenance. However, there is specific maintenance that should be done on a quarterly basis. The tasks are the following:

1. WEEDING
2. ADJUSTING WATER LEVEL
3. CHECKING FOR AND REMOVING SOLIDS AS NECESSARY
4. CLEARING OF DEAD VEGETATION IN THE LATE FALL
5. PERIODIC RAISING AND LOWERING OF WATER LEVEL
6. MAINTAINING BERMS AND DRAINAGE DITCHES
7. LEVELING OF THE GRAVEL.

1. WEEDING

Although the wetlands plants are generally very aggressive and can out-compete most other plants, there are some plants that must be removed. Noxious weeds and invasive species must be controlled. The main concern with these plants is that they may out-compete the treatment wetland vegetation and the ability of the aggressive roots to damage the wetland liner.

Weeds can be removed by manual pulling or by flooding. This can be accomplished by raising the water level to a depth of two inches above the surface; all weeds (if any) must be submersed. Flooding must be done within 24 hours or the weeds may grow faster than the rising level of the water. Lowering of the level should be done in stages to prevent flooding the next treatment step.

2. ADJUSTING THE WATER LEVEL

As the plants grow, their roots will partially fill voids in the gravel. This will change the hydraulic conductivity, which in turn may cause surfacing of wastewater in the front end of the wetlands. This can be corrected by lowering the water level using the level adjust basin standpipe arm. Normally an adjustment of one or two inches is sufficient. Water level should be maintained at 2" - 4" below the gravel surface. Raising and lowering is achieved by physically pushing the standpipe arm to the desired location.

Occasionally gravel will settle in a particular area, often at the front end of the wetlands. This can be remedied by filling with gravel and bringing the low spots up to the design finish level.

3. CHECKING FOR AND REMOVING SOLIDS AS NECESSARY.

Solids can accumulate in the settling chamber at the front end of the system and may result in surfacing of wastewater. Solids may be removed from the chamber by pumping them out. Check the level of accumulated sludge by sticking a CorePRO Sampler (model: 15-ft CorePRO Jr.) in the inspection ports. If the inspection ports show more than 8" of dark material in the chambers it is recommended they be pumped.

Under certain unusual circumstances surfacing occurs and cannot be corrected by adjusting the water level. If surfacing continues, clogging may be a problem that will require the following actions. Before working on the wetlands, use the diversion valves to temporarily divert effluent to the backup system.

a. Drain wetland cell.

b. Remove plants from the front 1/3 of the wetland cell. Trim plants down to 18"; place in water for re-planting.

c. Remove gravel from this area using a vacuum truck.

d. Remove and clean leaching chambers.

e. Replace leaching chamber, cover with clean gravel and replant.

4. CLEARING OF DEAD VEGETATION (ANNUALLY IN LATE FALL OR EARLY SPRING)

Thick mats of dead vegetation will accumulate over time and restrict growth of new shoots in the spring. Removal of this dead vegetation in the late fall or early spring, before the new shoots come up, will greatly assist the growth of new vegetation and enhance the appearance and treatment capabilities of the wetlands. Clearing can be accomplished by any of the following techniques: Machete, Scything, Power cutters or mowers.

5. PERIODIC RAISING AND LOWERING OF THE WATER LEVEL

Experience has shown that by periodically draining and filling the wetland cells, performance can be enhanced, and problems with solids build-up can be minimized. Draining and filling should take place during the late spring and summer months-May through September once or twice per month. Take any water quality samples required

by the permit prior to draining. Draining and filling can be accomplished easily by doing the following:

a. Remove or rotate the standpipe to the horizontal position in the level adjust sump. This may have to be lowered a few inches at a time to prevent flooding downstream treatment elements, or, a cap can be placed on the top of the standpipe, with a 1/2-inch hole drilled in the top. Then the standpipe can be rotated to the horizontal position.

b. Allow to drain for 16-18 hours. (Depending on the size of the wetland cell, it may take more than 16 hours to drain. Do not leave plants dry for over 24 hours.)

c. Replace or raise the standpipe to the starting level.

d. Repeat cycle at least 4 times per cell per year.

IMPORTANT! FAILURE TO RAISE THE WATER LEVEL WITHIN 24 HOURS MAY RESULT IN PLANTS DYING.

6. MAINTAINING BERMS AND DRAINAGE DITCHES.

Inflow of storm water carrying sand, silt, and dead vegetation will clog the wetlands. Sand and silt will fill the voids between the gravel and cause surfacing of wastewater. It is essential that the berms surrounding the wetlands and the drainage channels adjacent to the wetlands be kept in good repair. Check on a quarterly basis.

7. LEVELING OF THE GRAVEL

If surfacing of the effluent occurs in a few places, rake the gravel surface level, or add more gravel to the low spots.

D. TROUBLESHOOTING

Under certain unusual circumstances surfacing occurs and cannot be corrected by adjusting the water level. If surfacing continues, clogging may be a problem that will require the following action:

1. Drain wetland cell.

2. Remove plants from the front 1/3 of the wetland cell. Trim plants down to 18"; place in water for re-planting.

3. Remove gravel from this area using a vacuum truck.

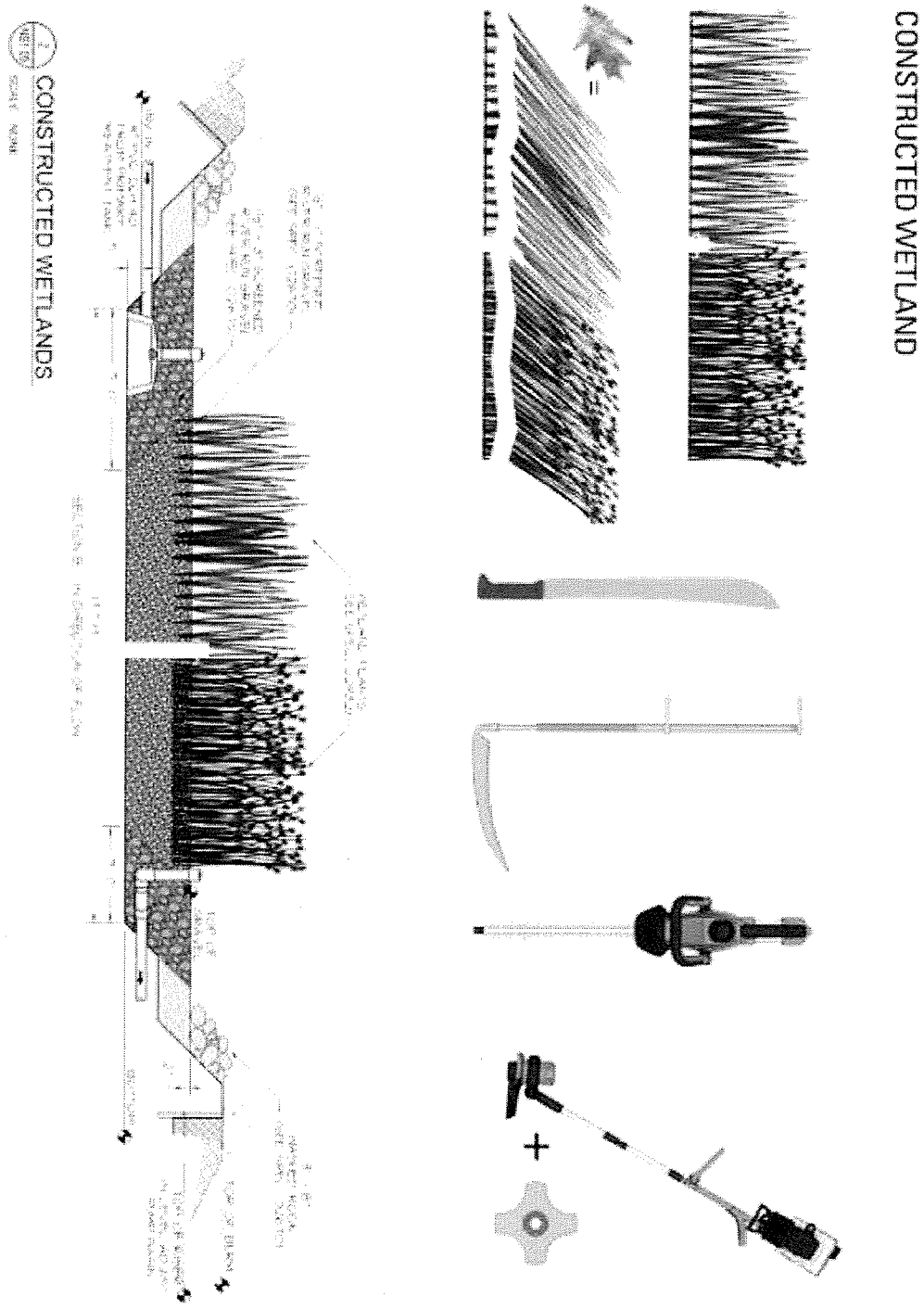
4. Remove and clean leaching chambers.

5. Replace leaching chamber, cover with clean gravel and replant.

E. COMPONENT GRAPHIC

The component graphic follows on the next page.

COMPONENT GRAPHIC



IV. ABSORPTION FIELD

A. OVERVIEW

A subsurface absorption field provides effluent disposal through the process of infiltration. The absorption field is constructed using infiltration chambers (i.e. gravel-less chambers) fed by a series of distribution boxes. The distribution boxes (D-boxes) allow the flow to be split evenly to each row of infiltration chambers. Cleanouts allow access from the surface for inspection and maintenance.

B. CONTROLS

The distribution boxes allow flow to be split evenly between the rows of infiltration chambers. The first distribution box splits the flow to two secondary, downstream distribution boxes plumbed in parallel. Each secondary distribution box splits flow to the infiltration chamber rows. Empty, unused holes should be capped. Each effluent hole is fitted with a leveling-device that can be twisted to ensure equal distribution. During typical operations, all rows of the absorption field should be utilized.

Long-term operation may result in the growth of biofilms on the floor of the absorption field. If biofilm accumulation appears to be inhibiting infiltration, the Operator may choose to alternate the two 'halves' of the absorption field by opening or closing the effluent outlet holes at the primary distribution box. The 'resting' period can range from several weeks to several months.

C. MAINTENANCE

The operator shall inspect the distribution boxes monthly for the first three (3) months of operation and then quarterly thereafter. The operator should clear any debris or biofilm build-up and ensure through visual inspecting while water is flowing that each box continues to split flow evenly.

1. DISTRIBUTION BOX

Clean outlet holes of the distribution boxes and associated leveling devices with a stiff brush if biofilms develop. Remove any debris.

2. ABSORPTION FIELD

Inspect the absorption field cleanouts for any indication of solids or debris build-up, or to measure water depth in the chambers. A 'sludge-judge' can be used to measure solids and liquid levels.

D. TROUBLESHOOTING

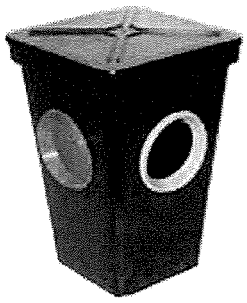
If surfacing occurs within the absorption field, this indicates that the system is not adequately infiltrating effluent. The 'back-up' system that consists of the existing primary treatment tank and leach field should be utilized in this case. Open the diversion valve that feeds the existing system and close the valve that feeds the new system.

Periodically 'resting' the absorption field can help revive infiltration performance since it allows time for the biofilm layer that often forms on the inner floor to break down. Rest periods can

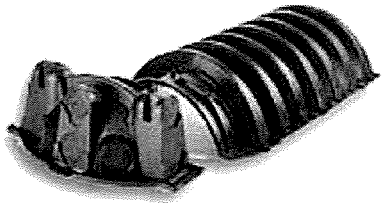
range from two (2) to six (6) months. Although 'resting' the absorption field is not considered a standard operation for this system, this technique could be used in the event of field failure. The

Other methods of field 'rehabilitation' exist and consist of aeration and addition of beneficial bacteria. These methods are beyond the scope of this manual; consult a local septic tank maintenance firm.

E. COMPONENT GRAPHIC



Typical Distribution Box



Typical infiltration chamber used in absorption field

3.0 START-UP OR RAMP-UP

I. OVERVIEW

The start-up of the treatment system should only occur once the system has been declared 'substantially-complete' (fully constructed and ready to operate) and all hydraulic and leak testing is complete. There are two options for start-up.

A. RAMP-UP OVER TIME

The preferred method of starting up the system is to introduce effluent to the system slowly by increasing the influent dosing over a period of a few weeks or months. The slow introduction of effluent allows the biology of the system – including microorganisms and plants – to adapt and

adjust. Before introducing wastewater to the system, the entire facility should already be full of clean water from the hydraulic and leak testing activities. This clean water serves to dilute incoming wastewater.

To provide a slow ramp-up period, the diversion valves may be periodically alternated between the new and old systems to essentially 'pulse' the new treatment system. An example schedule is included below, but can be adjusted by the Operator to accommodate actual use patterns:

Week 1 Open diversion valve M
Week 2 Open diversion valve Mon & Thu
Week 3 Open diversion valve Mon, Thu, Sat
Week 4 Open diversion valve Mon, Wed, Thu & Sat
Week 5 Open diversion valve Mon, Tue, Wed, Thu, Fri & Sat
Week 6 Open diversion valve Mon, Tue, Wed, Thu, Fri, Sat & Sun

A slow ramp-up period, although more maintenance-intensive, will allow the living treatment system to stabilize over time.

B. IMMEDIATE START-UP

The system may also be started-up immediately after completion and testing if a ramp-up period is not possible or desirable. The start-up procedure involves opening the diversion valve that feeds the new system while closing the valve that feeds the old system. The old system should be pumped out with a septic tank pumping truck to remove solids, and then immediately refilled with clean water (to avoid tank floatation).

II. BACTERIAL ADDITION AND SEEDING

To maintain microbial diversity in the system, the treatment system should be seeded with water from natural sources. Local rivers, wetlands and ponds close to the treatment system offer convenient seed sources. Biosolids maturation ponds are an excellent source of rotifers and nematodes. Local wetlands and farm ponds can also be a good source for a variety of plankton.

To ensure both planktonic and benthic organisms are introduced into the system, some of the seed water should be mixed with the top couple millimeters of mud under shallow water at the edge of a pond or wetland. Simply stirring up the water so that it is muddy when collected will suffice. The ideal seed source should have many tiny organisms, barely visible to the eye, swimming in the mixture. Be careful, however, to not include crayfish because they will voraciously consume plant roots and can be difficult to eradicate.

There is no precise reseeding schedule. Reseeding from natural sources certainly should be should done at start-up and after upsets. Bioaugmentation with sewage biosolids or commercial wastewater bacteria preparations may also be necessary after severe upsets. The schedule for seeding to maintain diversity is not clear because it is difficult, at best, to quantify diversity in precise engineering terms. Given the seasonal fluctuation of zooplankton populations in natural bodies of water, monthly reseeding of several

liters from each local source is an ecologically sound strategy to maintain a diverse microbial community in the system.

The most efficient locations to seed the system are at the wetlands influent header cleanouts. Benthic organisms in the seed water are likely to colonize the wetland media, hence placing a few liters of dilute bottom sediments into the wetlands is a sensible strategy.

4.0 PLANT HEALTH AND MANAGEMENT

The most important function of plants within the system is to provide a large surface area of submerged roots to which immobile forms of bacteria and other microorganisms attach themselves. These attached biofilms are microbially diverse and contribute significantly to treatment. Maintaining the health of the plants so that they will provide large root systems is an important operator task. By following a few simple guidelines, the operator can maintain vigorous plant growth and health.

I. GROWTH AND MANAGEMENT

Plants are dynamic, living organisms, therefore inherently require periodic maintenance in order to continue to produce healthy roots and shoots on a long-term, sustained basis within the wetlands. During the first months and years of the system, regular weeding and removal of nuisance species is crucial to ensuring that the intended wetlands species populate the wetland bed. After the wetlands plants are well-established, seasonal weeding should keep berms, edges and the wetland bed free of weeds.

Pruning (removal) of dead, diseased, or heavily overgrown plant tissue also reduces the incidence of pest insects and disease, which can cause considerable damage or death to the plant. Optimal plant health and appearance is maintained when plants are given individual attention (based on species) on a regular basis. Most species should be pruned back heavily if they become heavily infested with insects.

Suggested plant maintenance tools include a 10-14" knife, hand pruners, a pair of scissors, and appropriate gloves. Try to keep the edges sharp; dulled blades can result in injury to the plant. Clean, sterile blades are also important. In order to reduce the possibility of spreading disease, it is recommended that you periodically wash your tools in hot water and dish detergent. In order to reduce the possibility of spreading disease, it is recommended that you frequently dip the blades into a 1% Clorox/water solution to reduce the possibility of spreading disease (e.g., microscopic fungal spores).

II. PEST AND DISEASE MANAGEMENT

Pest insects represent a challenge to plants in the wetlands by consuming appreciable amounts of plant tissue or removing considerable amounts of valuable molecules from vascular tissue. The impact on visual appeal notwithstanding, pest insects may also act as vectors for disease transmission, so the better the control, the less likely serious problems will develop. Plants experiencing any type of stress (drought, temperature extremes, disease, etc.) are more susceptible to insect attack. Also, plants under severe stress do not grow. Growth often slows down or ceases until the stress has been alleviated or the plant perishes. Therefore, pest infestation adversely impacts wastewater treatment.

From the experiences at other facilities, four types of insects have been predominant, each presenting a variety of challenges to healthy plant growth. The four primary pests thus far encountered include: aphids; spider mites; thrips and white flies. Each pest appears to favor specific plant types although adjoining species may periodically be infected when population density reaches a level where it can no longer be supported on the original 'target' plant. Summertime insect management is more critical. In winter, thrips and spider mites generally disappear and aphid and white fly infestations drop dramatically.

The goal of pest management is to minimize insect damage. Total elimination of pests is not ecologically sound. It is recommended that the operator inspect the leaves of plants at least weekly for insects or other problems. If a problem is detected early, before it erupts into a real challenge, control will be easier.

Natural systems use an environmentally sound approach to wastewater treatment, and insect control. Synthetic insecticides should never be used to control pest populations. These chemicals can harm organisms that reside in the wastewater, such as the beneficial bacteria. They may also linger in the effluent as a harmful pollutant to receiving waters.

Populations of pests depend on the time of year, the presence of natural predators, the regularity of scouting, as well as the method of control. The best way to keep insect populations at a tolerable level (not affecting plant growth) is to regularly check foliage and flowers for insects and disease and deal with infestations before they become widespread. When potentially harmful insects are observed, such as aphids on stems and leaves, first use a forceful spray of water from a hose to dislodge insects from affected plant parts. Alternatively, it is safe to remove and compost any affected leaves, which produce prodigious growth throughout the growing season.

If an insect pest problem continues or worsens, the next recourse should be a regular application (usually weekly) of insecticidal soap, or other natural insecticide such as bacteria or fungal insecticides. Myco-insecticides use a genus of fungi that has insecticidal properties. BotaniGard is a naturally occurring fungus for control of white fly, aphids, thrips and mealy bugs. Myco-insecticides are an excellent supplement to a fine horticultural oil mix spray. Other natural wastewater treatment facilities have used M-Pede brand insecticidal soap (formerly Safer Insecticidal Soap), which is a concentrated contact insecticide containing natural occurring fatty acids effective on adult and immature stages of labeled insects and normally applied at 110-170 ml/liter. These compounds are commonly available, in concentrate form, at local garden centers or horticultural wholesalers.

Spray must make contact with the insect or it won't be effective (i.e. do not use as a preventive spray). Since insect carcasses will likely remain attached to the leaves for several days to several weeks after spraying, use a small hand lens (10-20X) to determine that the insecticidal soap has killed the insects. Do not spray newly rooted cuttings or plants suffering from transplant shock. Insecticidal soap is not systemic, and, therefore, does not create a long-term residual effect.

An insecticidal soap, used according to package directions, should not cause damage to plant foliage. To test the effect of the soap on new plant species, apply the material to a small leaf section and wait a couple of days. If the leaf is not damaged, it is probably safe to use.

A lightweight, plastic backpack sprayer is the recommended delivery system for efficient and effective coverage of plants. It is very important that the sprayer be dedicated solely to the treatment system to

avoid the introduction of chemical insecticides that might be used at other times in the sprayer. Aquatic organisms are extremely sensitive to chemical pesticides and the introduction of chemical pesticides.

Biological controls using purchased pest predators can be a viable option for persistent problems that have not yielded to methods outlined above. Consultation with a local integrated pest management (IPM) specialist before considering biological controls is highly recommended because the predators are often very specific to a pest species and will not prey on others.

It is also recommended that the operator encourage the presence of spiders and other natural predators (lady bugs, damsel flies, praying mantis, etc.). Avoid spraying these species with high pressure water or insecticidal soap.

Plant diversity serves to reduce pest populations. As time permits, you may wish to add species from your own local wetland areas to increase the diversity in the wetlands.

5.0 SPRING OR SEASONAL MAINTENANCE

I. OVERVIEW

Wastewater treatment in the Wastewater Treatment System is the result of bacterial digestion of organic and inorganic compounds. Bacteria account for approximately 90% of the treatment process. Any disruption of the bacterial population will have an immediate and significant impact on the level of treatment. Disruption may be chemical or thermal. Bacterial activity is temperature dependent and reaction rates generally halve with a 10° C drop in temperature. Since the site is tropical, temperature fluctuations are not anticipated to be an issue.

Prudent use and disposal of chemical disinfectants, cleaners and solvents will prevent a chemical disruption. As the wetland matures and the root systems of the wetland plants become thicker, thermal disruption will be decreased due to the insulating capacity of the plants and plant detritus. During the first two or three years (or after a chemical upset), nitrifying bacteria should be added in the spring to establish the bacterial populations necessary for the conversion of ammonia nitrogen to nitrate nitrogen. Nitrifying bacteria may be obtained through either Natural Systems International, or from:

General Environmental Science
29603 Hall Street
Solon, Ohio 44139
Ph: 800-544-5566
Specify GES LLMO N-1 Bacteria.

II. BACTERIAL ADDITION (NITRIFIERS)

The procedure for the addition of the nitrifying bacteria for a catastrophic re-start or spring inoculation is as follows (follow manufacturer's directions if different):

A. Add one (1) gallon of the N-1 bacteria to a five-gallon bucket. Add three and one half (3 1/2) gallons of water to the bacteria, allowing three to four inches of freeboard in the bucket.

B. Activate the bacteria by bubbling air through the water for 24 hours. This may be accomplished with a small aquarium air pump. Activation is not required, although the bacteria will perform better if it is done.

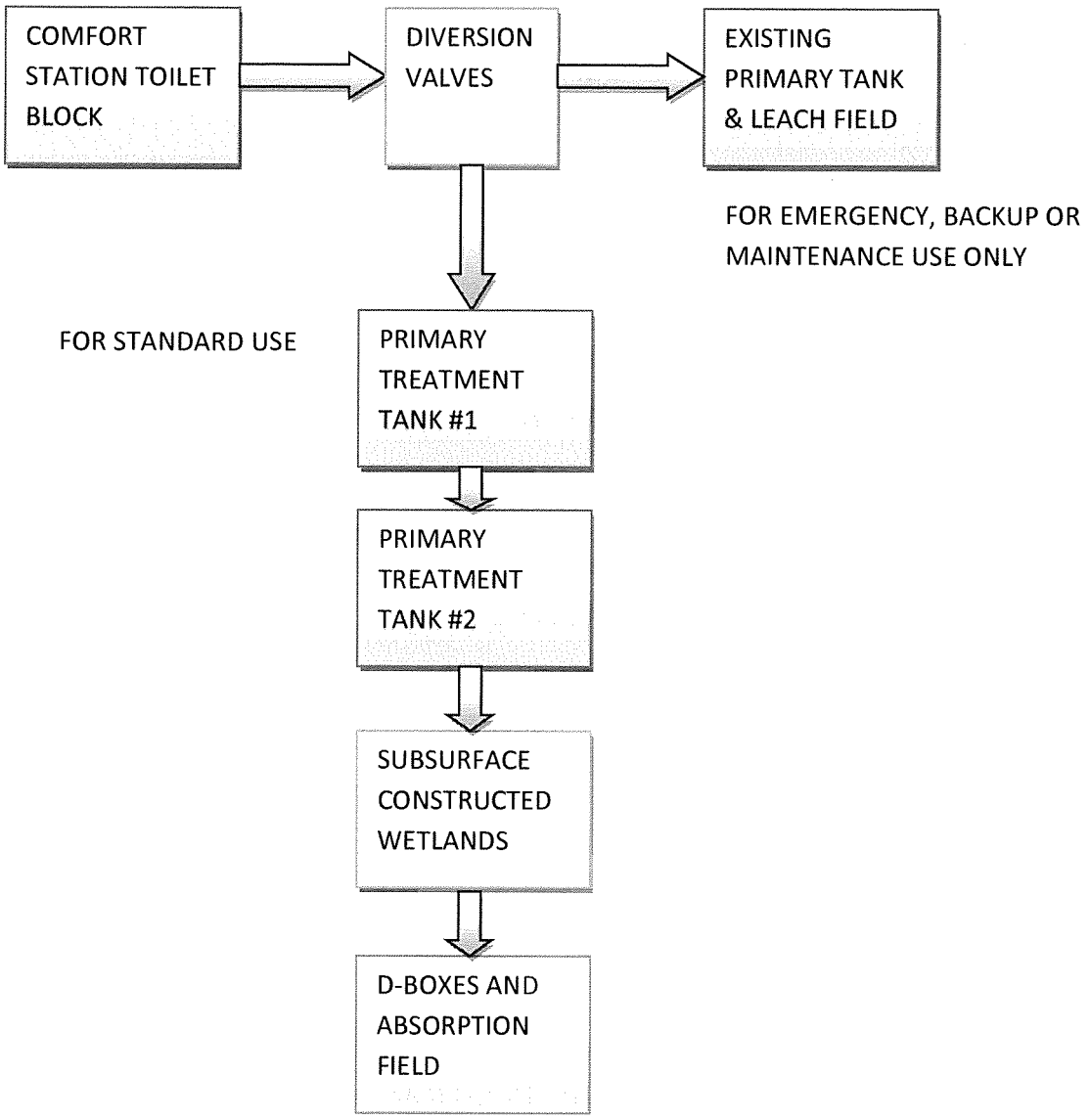
C. Add two (2) gallons to the pretreatment tank.

It is recommended that the addition of bacteria to the system occur at a minimum of twice a month during March, April, May, and June. Treatment levels will dictate if the bacteria dosing schedule should be changed.

III. ADDITIONAL BACTERIAL APPLICATIONS

In addition to the nitrifying bacteria, several other products are available for other remediative processes. Solids loading from the septic tanks may be unavoidable. General Environmental Science can provide a bacterial product for the specific role of solids digestion. Application of the bacteria would be directly added to the septic/pretreatment tank in this case. A one (1) gallon bottle added every other month to the system tank may prevent solids loading problems in the wetlands.

6.0 SCHEMATIC DRAWING



7.0 MAINTENANCE SCHEDULE AND SUMMARY

I. WEEKLY AND MONTHLY MAINTENANCE

SYSTEM COMPONENT	ACTIVITY
Pretreatment tank s	Visually Inspect effluent filter in pretreatment tank (Monthly).
Level Adjust Sump Standpipe	Visually inspect standpipe for obstructions or blockages (Monthly).
Constructed Wetland	Weed weekly to monthly depending on growth
Absorption Field	Weed weekly to monthly depending on growth

II. QUARTERLY MAINTENANCE CHECKS

SYSTEM COMPONENT	ACTIVITY
Constructed Wetland ***NOTE: Do the following visual checks and corrections.***	1. Weed species that become very dense. 2. Adjust Water Level in wetland to maintain 3" - 4" of gravel over water level. 3. Cut and remove dead vegetation as needed. 4. Periodically raise and lower water level. 5. Maintain berms and drainage ditches. 6. Fill in areas of Wetland that are low.

III. SEMI-ANNUAL MAINTENANCE CHECKS

SYSTEM COMPONENT	ACTIVITY
Pretreatment Tank	1. Check with Core-Pro sampler for sludge depth and spray off effluent filter cartridge.
Absorption Field	1. Inspect D-Box to ensure even flow-splitting. 2. Inspect solids levels in absorption field cleanouts.

IV. AS NEEDED MAINTENANCE CHECKS

SYSTEM COMPONENT	ACTIVITY
Alarm Conditions@ Primary Tank #2	1. Determine alarm condition and follow appropriate troubleshooting section to address cause of alarm. Clean effluent filter using hose.

8.0 SYSTEM TROUBLESHOOTING

I. MASTER PROBLEM CHECK LIST

The following list is representative of typical problems that have been encountered by operators of these types of systems. This list is not all-inclusive. If you are having problems not described below, call either the manufacturer, contractor, or engineer.

SYSTEM PROBLEM	CORRECTIVE MEASURES
Back-up of sewage into Building	1. Check building traps for blockage; use metal snake or remove trap to clean. 2. Check sewer line between building and pretreatment tanks for blockage or obstructions; use metal snake to clean line if necessary. 3. Check second pretreatment tank for high level alarm condition, liquid level and sludge accumulation.
Odors in buildings	1. This can be caused by wastewater traps under sinks or floor drains going dry. Fill with water. 2. Check clearance on roof from sewer vent pipe to any intake air heating or cooling system.
Odors from Constructed Wetlands **NOTE: A properly operating wetland should be odor free.**	1. Check for standing water. Water level must be 3-4 inches below gravel surface. If not, lower water level or fill in low spots with gravel. 2. Check seals/gaskets and/or lids on flow splitters and level adjust sumps. 3. Tighten lids or repair or replace gaskets.
Barren areas in Constructed Wetlands	1. Plant mortality occurs with new plants, and may exceed 20%. Replant areas that are void of plants. The Spring is a good time to plant barren areas.
Level Adjust Sump Overflowing	1. Check line from Level adjust sump to disposal field for blockage. If blocked, use metal snake to clean line. 2. Check standpipe for blockage.
Effluent Surfacing in Constructed Wetland	1. Lower water by using level adjust standpipe and determine if the wetland received a high volume of effluent or rain.
Effluent Surfacing in Absorption Field	1. Switch diversion valves to send effluent to backup/existing system. 2. Check biofilm or solids levels in absorption field. 3. Remedial action (resting, aeration, bacterial addition, etc) may be required.

9.0 RECORD KEEPING

It is important to keep detailed records of any maintenance, repairs, or problems that arise in the wastewater treatment and reuse system. Dating records will help provide a baseline for trouble shooting the system if problems arise. A sample table follows below:

INCIDENT	DESCRIPTION	DATE

10.0 CONTRACTOR CONTACT

THIS SYSTEM WAS BUILT BY:

11.0 ENGINEER CONTACT

THIS SYSTEM WAS DESIGNED BY:
Natural Systems International, LLC.
3600 Cerrillos Road, Suite 1102
Santa Fe, NM 87507
Phone: 505.988.7453
Email: nsi@natsys-inc.com
www.natsys-inc.com

STATE OF HAWAII DNLR PROJECT ENGINEER:
Val Suzuki
808-587-0275

Failure to comply with the conditions of the design, plans, specifications, permit application, conditions of permit approval, and/or this manual may result in the failure of this treatment system.

APPENDIX A
CONSTRUCTION DRAWINGS, PLANS AND DETAILS

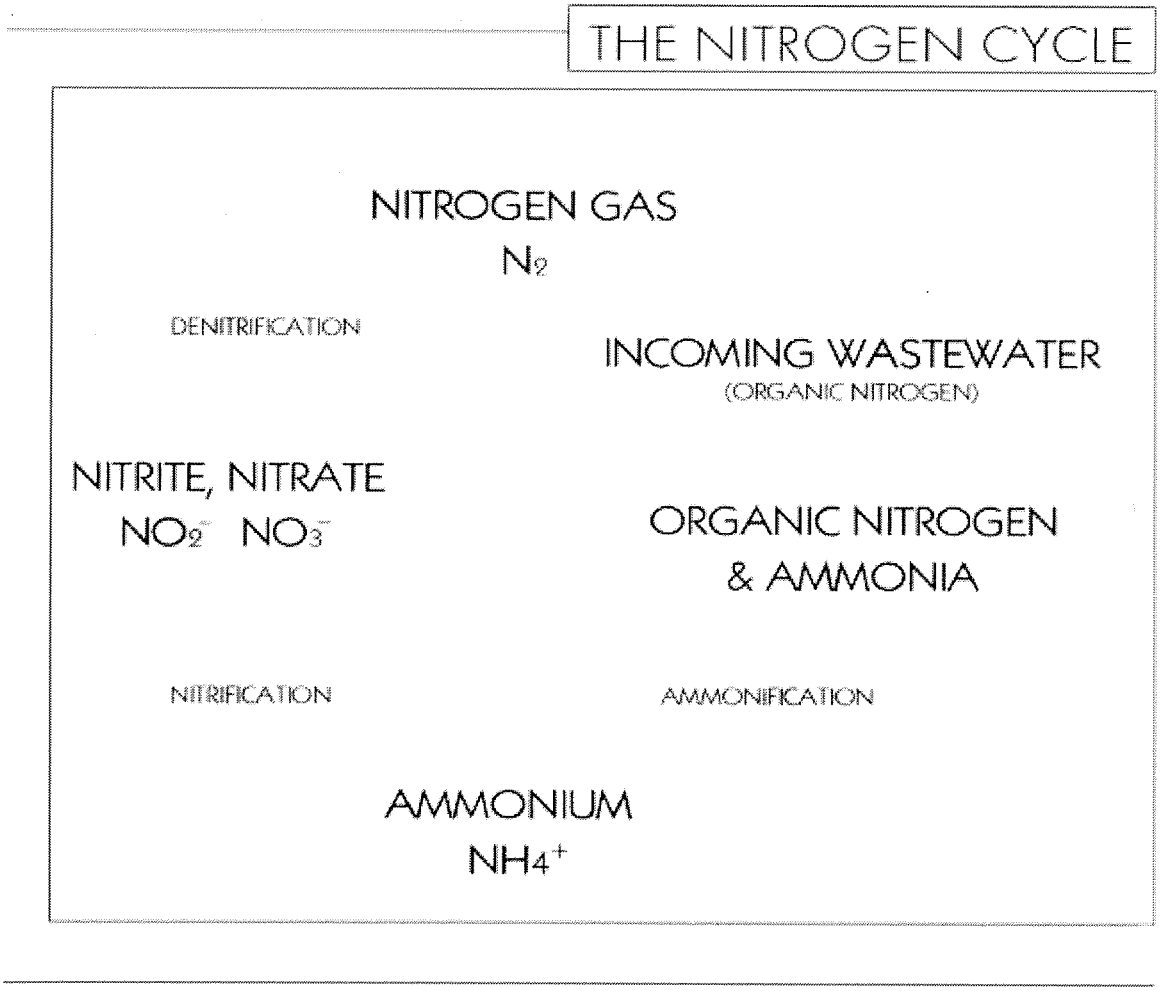
Refer to Construction Drawings and Specifications

APPENDIX B

APPENDIX C
EQUIPMENT MANUALS

APPENDIX D
EXPLANATORY GRAPHICS

UNDERSTANDING THE NITROGEN CYCLE



APPENDIX E

LIST OF ALTERNATIVE CLEANING PRODUCTS

LIST OF ALTERNATIVE CLEANING PRODUCTS

PURPOSE	LESS TOXIC ALTERNATIVE
Aluminum spot remover	2 tablespoons cream of tartar + 1 quart hot water
Bleach	Borax
Car battery corrosion	Baking soda + water
Cleaners; general household	Baking soda
Coffee cup stain remover	Moist salt
Copper cleaner	Lemon juice + salt
Dish detergent: grease cutter	½ cup baking soda + usual amount of liquid detergent
Drain cleaner	Plunger followed by ½ cup baking soda + ½ cup vinegar + 2 quarts boiling water
Fertilizer	Compost and vermin-compost
Furniture polish	1 tablespoon lemon oil in 1 pint mineral oil
Garbage disposal deodorizers	Used lemons
Grease removal	Borax on damp cloth
Hand cleaner: paint/grease	Baby oil
Ink spot remover	Cold water + 1 tablespoon cream of tartar + 1 tablespoon lemon juice
Laundry detergent	Basic soap
Linoleum floor cleaner	1 cup white vinegar + 2 gallons water
Mildew remover	Equal parts of vinegar and salt
Oil stain remover	White chalk rubbed into stain before laundering
Oven cleaner	2 tablespoons liquid soap + 2 teaspoons borax + warm water
Paint; oil based/stain/spray	Water-based, non-aerosol paints
Paint brush softener	Hot vinegar
Perspiration spot remover	Baking soda
Pet odor remover	Cider vinegar
Rug/carpet cleaner	Club soda
Rust removal (clothing)	Lemon juice + salt + sunlight
Scorch mark removal	Grated onion
Scouring powder	Baking soda
Shaving cream	Brush and shaving soap
Silver Polish	1 quart warm water + 1 tablespoon baking soda + piece of aluminum foil + 1 tablespoon salt in glass dish; soak silver, rinse and dry
Spot remover	Club soda, lemon juice, or salt
Stainless steel polish	Mineral oil
Toilet bowl cleaner	Paste of borax + lemon juice
Tub and tile cleaner	1.4 cup baking soda + 1.2 cup vinegar + warm water
Water softener	1.4 cup vinegar
Wine stain removal	Salt
Window cleaner	2 tablespoons vinegar in 1 quart warm water
Wood polish	3 parts olive + 1 part white vinegar; almond or olive oil (interior unvarnished wood only)

Source: National Management Measures Guidance to Control Nonpoint Source Pollution from Urban Areas Tacoma-Pierce County, Washington, Health Department.

Pre-Bid Meeting Minutes Job No H53C664B, Haena State Park, IWS Improvements (Constructed Wetlands), Haena, Kauai, Hawaii

Date: May 18, 2010 Commenced at 9:10 a.m.

Location: Engineering Division, Conference Room, 1151 Punchbowl Street, Room 221.

Meeting was opened by the project engineer, Valerie Suzuki, who stated the following:

Brief Description of Project and Scope:

- New sewer line from the existing comfort station,
- Two 1,500 gallon septic tank,
- 1,530 S.F. constructed wetland,
- 1,358 S.F infiltration field for subsurface disposal, and
- 6' high protective fencing

The entire system is gravity flow from the comfort station, septic tanks, wetlands and then to the infiltration field.

Bid Opening is on June 3, 2010 at 2:00 p.m. Bids will be at 1151 Punchowl Street, Honolulu, and at the Division of State Parks, Kauai Office in Lihue.

Last day to turn in RFI's is May 25, 2010.

Archeological Monitoring – A monitoring plan will be required for the project. The monitoring plan is currently being prepared. The constructed wetland is in the vicinity of known subsurface archeological deposits including a previously discovered burial adjacent to the existing septic tanks. Accordingly, archeological monitoring is required for all excavation work. The monitoring will be conducted by the State so cost for this work is not included in bid proposal. Archeological test pits were previously excavated in the middle of the project area and no signs of archeological artifacts were found. The complete monitoring plan outline is included in Addendum 1.

The following clarifications (C), questions (Q), and answers (A) were made:

C1 The existing septic tank and leach field system will remain in the ground. It will be used as a back-up system to the constructed wetland system.

C2 The plans show the delineation of the natural wetland. No fill is allowed in the natural wetland.

C3 There is a weight limit on the bridges going to Haena State Park. It is the responsibility of the contractor to verify the weight limits and bid his job accordingly.

Q1 If archeological bones are found, and work is stopped, does the contractor receive time extension to the contract time.

A1 Yes. A time extension will be granted.

Q2 What is the anticipated start date?

A2 The earliest start date would be approximately September 2010. It takes a few months to process the construction contract.

Q3 The plans show a 1% slope from the comfort station to the septic tank. Is that correct?
A3 Yes. The constraints of the site conditions and to meet gravity flow requirements for the entire system limited the slope to 1%.

Q4 If the contractor installs the pipe correctly at 1%, and a clog or blockage occurs because the slope is so flat , is the contractor liable to correct the problem during the warranty period?
A4 No, if the pipe was installed per plans and specification, the Contractor is not required to correct the problem.

Q5 How long does the Contractor need to provide operation and maintenance of the system?
A5 2 years.

Q6 Do the specifications spell out what is required for the 2 years of operation and maintenance?
A6 An operation and maintenance manual will be included in Addendum 1.

Q7 Are there any boring logs?
A7 No. Only test pits were excavated for percolation test, archeological testing, and natural wetlands delineation.

Q8 What kind of soils are there [in the project site]?
A8 The location of the constructed wetland has mainly clay soil and the area around the comfort station has mostly sandy soil. Between the comfort station and the constructed wetland, the soil transitions from sand to clay.

Q9 Why use constructed wetland [to treat wastewater]?
A9 Constructed wetlands can treat the wastewater without the use of chemical or major electrical components (Haena has no electricity) so it is a passive system. Water quality that comes out of the wetlands is significantly better than a septic system so cleaner water is being disposed of into the ground.

Q10 So the idea of the [constructed wetland system] is that the wastewater will flow from the septic tank to the wetland, stay there for awhile, and then get dispersed into the leach field [infiltration field]?
A10 Yes, the main operating principle is detention. You basically create a habitat for bacteria in the wetland to treat the wastewater.

Q11 Will there be any odors coming from the constructed wetland?
A11 No.

Q12 The plans show electrical work. What is this?

A12 The electrical work is a simple battery operated high level alarm system that is installed in the second septic tank and connected to an alarm control panel in the comfort station storage room.

Q13 Will it be the contractor's responsibility to do the operation and maintenance of the system?
A13 Contractor must provide 2 years of operation and maintenance of the system.

Q14 Do we have to worry about any sheet flow of rainwater flowing towards the constructed wetlands?
A14 The wetland is bermed up and there is a drain swale to divert runoff to the natural wetlands.

Q15 What permits are required for this project?
A15 Contractor to obtain an NPDES permit if construction area exceeds 1 acre as defined by the Department of Health.

SIGN-IN SHEET
PRE-BID CONFERENCE

Job Number: H53C664B Date: May 18, 2010 Time: 9:00 a.m.
Job Title: Haena State Park , IWS Improvements (Constructed Wetlands) Haena, Kauai, Hawaii

	NAME	AGENCY	PHONE NO.	FAX NO.	EMAIL ADDRESS
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3	Lauren C. Roth Vena	Roth Ecological Design	781-7583	732-4597	lauren@rothecological.com
4	JAMES KINCAID	Team Spec Y	394-1444	921 1414	JKincaid@fley.com
5	DUREK	SITE ENGINEERING	841 8883	842 0320	BIDS@SITE-ENGINEERING.COM
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